

Going Virtual: Reflections from Research and School Educators on Navigating Professional Development and STEM Club Opportunities

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Going virtually: Reflections from research and school educators on navigating professional development and STEM club opportunities (Poster, Diversity)

Abstract

Influencing the rates of women, African American, Hispanic/ Latino, American Indian/ Native American, and low-income persons in STEM occupations is an ongoing goal for various STEM fields. Catalyzing Inclusive STEM Experiences All Year Round (CISTEME365) is a multi-year project to increase these groups' participation in STEM majors and careers. Through content grounded in STEM equity and practices, we worked closely with middle/high school teachers, counselors, and administrators across the state of Illinois to 1) establish a network community, 2) design, extend, and implement informal STEM-learning clubs during the summer with hands-on, project-based engineering tasks, and 3) connect young people to engineering-based summer learning opportunities including industry exposure. In the face of the global pandemic, professional development opportunities for educators and informal learning experiences for students demanded new adjustments to content delivery unseen before. We discuss our leadership team's adjustments to online content delivery and school educator's efforts to create and sustain a virtual STEM club through reflexive practices. Specifically, we transitioned a 10-day, in-person professional development during the summer to a 5-day, blended professional development, where asynchronous and synchronous activities were led by CISTEME365 staff. Additionally, we adjusted our STEM equity and content materials for school educator's immediate use for the virtual-formatted school year. We developed our professional development practice around remaining flexible and accessible (via check-ins, discussion forums, email, and open office hours) to school educator participants. In collaboration with school educators, we discuss the challenges and promises of virtual content delivery. We offer insight into how to deliver the best both virtual professional development and informal STEM club opportunities for all students and educators going forward. This material is based upon work supported by the National Science Foundation under Grant No. 1850398.

Introduction

Persistent racial, ethnic, and gender inequalities are well documented in the literature on science, technology, engineering, and mathematics (STEM) fields [1]. Since Black, Native American, Latinx, first-generation, women, and low-income persons are historically underrepresented in STEM (URs) fields in the United States (U.S.), these students attain STEM degrees and careers at lower rates compared to their peers [1]. These STEM pipeline inequalities affect the STEM U.S. job market unless we address STEM diversity and access issues in a multi-layered manner. Research supports the essential role of STEM enrichment opportunities in improving students' STEM attitudes, knowledge, and skills [2]–[4]. School counselors serve as important gatekeepers for informal learning opportunities, yet counselors are often underutilized to increase students' awareness and interest in STEM [5]. We believe it is vital to include counselors in STEM-equity efforts. Our work relies on counselors to create, connect, and maintain students' STEM interests to STEM learning opportunities all-year-round.

Catalyzing Inclusive STEM Experiences All Year Round (CISTEME365) is a National Science Foundation (NSF), multi-year project designed to offer professional development experiences for school educators to address informal STEM learning inequalities across the state of Illinois. Our project features three targeted programming components (see Appendix A). First, professional development is provided for school-based teams made up of counselors, teachers, and other relevant school stakeholders called IDEA Teams (Inclusion, Diversity, Equity, and Access). Professional development sessions focus on engineering project implementation and creating equitable and inclusive STEM environments. As outcomes of the initial 10-day training session, members of these teams develop action research for equity projects (AREPs) in their home schools with the purpose of creating more equitable and inclusive STEM environments. Additionally, they plan for the implementation of informal STEM-enrichment clubs in their school settings. Networked Improvement Community (NIC) meetings were held virtually each month throughout the first school year to allow IDEA Teams to discuss their progress on implementation of their AREPs and STEM clubs. In addition to the professional development, we supported the IDEA teams in creating and sustaining a STEM-enrichment club at each school site. At the beginning of the school year, each school site received materials to support technology-rich, hands-on experiences for up to 50 students. In the middle of the school year, additional funding supported site-specific interests for STEM materials. The school educators were also exposed to other STEM activities such as the annual Health Make-a-Thons (HMT) organized by the Health Maker Lab at the Carle Illinois College of Medicine, and were encouraged to establish Health Innovation Clubs at their schools. Lastly, our final targeted programming offered fully-covered scholarships for STEM club student participants to attend STEM-immersive summer camps at our home institution. Beyond the first year, we continue to contact IDEA teams to share resources and opportunities for their students and families to use.

During the second year of CISTEME365's three-year, multi-layered programming, the COVID-19 global pandemic significantly changed everyday life. These changes required greater use and reliance on technological tools to address STEM inequalities and inequities. Despite many of our programming interventions being planned for in-person contact, we adjusted our expectations and content delivery to carry on despite the pandemic, shifting our professional development training to 100% virtual, as well as supporting schools in planning and

implementation of virtual informal-STEM learning opportunities. In this paper, we partner with one of the 2020-2021 IDEA Teams to discuss the decision making process, the successes, and the challenges of delivering online content and establishing virtual STEM-enrichment clubs, providing insight on best practices for leading virtual professional development and informal-STEM learning opportunities.

Objectives

For this work, we explored the following research questions: What are success and challenges for delivering virtual programming and what are the takeaways for delivering virtual professional development training and STEM-enrichment experiences for others to consider? To examine these questions, we worked with two school educators and our CISTEME365 leadership team to understand the adjusted curricular strategies for implementing virtual professional development training and STEM-enrichment clubs for URSs in K-12 school settings. We collected and reviewed interviews and reflective memos on strategies and adjustments for virtual content delivery following the widespread effects of the COVID-19 global pandemic on everyday life. Because this study remains a work in progress, we will share some of the takeaways that we have gathered thus far. Additional details about our participants, data collection, and recruiting techniques and processes follow.

Research Design

With the forecast of COVID-19 impacting all in-person experiences during the summer of 2020, we met during the months of April and May 2020 as a CISTEME365 leadership team to discuss the implementation of strategies and best practices to promote and sustain our program going into the summer. We proceeded to collect audio recordings, meeting minutes, and reflective memos through January 2021. Additionally, we worked with two participants from one of our participating school sites to understand how they navigated our professional development training and their practices in creating and sustaining a virtual STEM-enrichment club. We proceeded to facilitate a conversation about their experiences during January 2021, during which we audio and video recorded our interviewed discussion. Two of the authors of this poster reviewed and developed codes to all data sources to inform the findings presented in this work. We shared our findings and takeaways with our school site participants and the CISTEME365 leadership team, which allowed development member reflections. For participating in our CISTEME365 programming, each participant received \$1,200 stipend costs for the summer Institute's program length. Participating school sites also received \$3,000 kits of engineering materials for supporting STEM-enrichment clubs throughout the school year, and each school site received an additional \$1,500 for additional STEM-related equipment and kit spending. An ethics review board approved our study, and we received consent from each participant.

Preliminary Findings

Using inductive and open coding analyses on the audio recordings, meeting minutes, and reflective memos, our work explores the key learnings, challenges, and lingering questions from virtually delivering professional development. CISTEME365 leadership team and school educators shared key themes related to *negotiating online expectations through being intentional*,

online accessibility, and giving grace and empathy. We will share preliminary findings related to these key themes before offering conclusions and takeaways.

Intentionality when negotiating online expectations

CISTEME365 leadership team shared about the relevant processes and structures pertinent to delivering virtual programming effectively. Before starting our summer Institute program, CISTEME365 leaders acknowledged difficulties developing relationships and connections between school participants and achieving deep conversations using a virtual format. CISTEME365 leaders also faced challenges, including navigating choice/use of the best virtual tools considering school and university policies and restrictions and successfully identifying the critical, virtual contact time for optimal learning and professional development.

Despite these considerations, CISTEME365 leaders were intentional about monitoring and acknowledging Zoom fatigue's role. In doing so, CISTEME365 leaders directly responded to this by transitioning our 10-day, in-person professional development to a 5-day, blended professional development, where asynchronous and synchronous activities were led by CISTEME365 leadership staff. CISTEME365 leaders also allowed 50 minutes for work time and 10 minutes for break time, established group norms, performed regular check-ins via the Google Jamboard platform, and used this tool to account for their comfort and level of engagement regularly. To spur small group discussions, CISTEME365 leaders allowed breakout space and mimicked group chart paper discussions via breakout groups and access to the Google Slides platform with instructions and prompts. In contrast, we lost the ability to move around the room, listening to multiple small group conversations for formative assessment purposes. But the virtual chart paper provided a method of monitoring responses across multiple groups in a less invasive manner than moving in and out of small group breakout rooms.

Taken altogether, these virtual experiences led our CISTEME365 leadership team to consider the following for future professional development programming: revising our delivery of STEM equity and technical content during professional development (i.e., consider dividing, again, the STEM equity and technical content) to improve participants' understanding, evaluating participants' knowledge of professional development content via various formative assessments (i.e., discussion questions and low-stakes quizzes), and adjusting our video curricular materials for both school staff and student access.

Our school partners discussed the value and quality of our professional development content. One school partner shared:

[...] From the perspective of professional development, [...] I believe the professional development through CISTEME is [...] top-notch, excellent in every aspect. Particularly, just the engineering, hands-on, critical thinking, [and] problem-based learning [PBL] [...] activities that we have the opportunity to partake in as well as its well-rounded with the morning portion of access and make [STEM] accessible to all students. And giving teachers the development and the training alongside PBL activities. - 6th Author

As a school educator, the 6th Author's view of our virtual professional offerings reflects the meaningfulness and intentionality that the CISTEME365 Leadership team considered in delivering virtual content. 5th Author goes as far as to say that:

Considering the subject matter is involved, what I love about this PD is that how the intimidation was removed around the subject [of STEM]. So everything was step-by-step, so during the afternoon sessions, you had materials laid out in front of you [and with] clear instructions [...]. [...] Everything was well interconnected with one another so we understand that even as adults, how some of us were intimidated by the projects initially, and just having that double vision, [...] help[ed] us [questioned] how our students feel [...] - 5th Author

The *double vision*, as described by the 5th author, really is the hallmark of our professional development regardless of being in-person or virtual. Moving into Year 2, CISTEME365 Leadership team considered the siloed effect of delivering STEM equity and technical content on separate days during Year 1 of CISTEME365 programming. To combat this during Year 2, CISTEME365 leaders intentionally included both STEM equity and technical contents on each day of the professional development. Therefore, this *double vision* speaks to the unique program takeaway of our *interconnected* professional development on STEM-equity and STEM-content delivery as well as the need to create conditions for educators to reflect on the unique mindsets and needs of current and future URSSs.

Overall, CISTEME365 leaders shared about negotiating online expectations through remaining forward-thinking and intentional.

Online accessibility

CISTEME365 leadership team and school educators also discussed the importance of curricular access through multiple virtual means. Going into the summer and school year sessions, CISTEME365 leaders did encounter difficulties with the time allotted for the virtual format, checking-in with participants' conceptual understanding of curriculum materials, and confirming usability and access of online software across school settings. Ensuring technological tools were accessible was also another critical learning that the CISTEME365 leadership team addressed. This included identifying an easy-to-use learning management system (LMS) platform, providing ample time and space for participants to interface with new technologies, including instructions and shorten links in the Zoom chatbox, moving at a slower pace during technical content activities, live sharing and pre-recorded videos, and responding to feedback directly and immediately. Specifically, a member of our leadership team noted:

Some of the things that I learned is that the timing for doing things virtually need to be extended. Most of the activities require one and half to double the amount of time I tried to use. There's definitely disconnects as to when you try to explain something, and people are able to see what's going on. Instead of reaching out and twisting my hand or angle something so that they can see something, we try to explain things through words or videos of us moving things around, and it is not always easy to communicate. - 8th Author

In short, Author 8 shares how going virtual led to changes in how the CISTEME365 leadership team thought about and facilitated existing, in-person curricular materials for virtual learning settings. While easing technology navigation for school partners alleviated some of the difficulties delivering an online STEM club, school partners continue to identify challenges delivering remote learning opportunities. Being consistent and considerate with online materials offered opportunities for participating school staff and students to access curricular materials.

In response to COVID-19's remote instruction requirements, school educators plan to assure STEM club content and activities are accessible for students in online formats (e.g., exercises, videos, simulations), market STEM club in various forms (e.g., attending and sharing information at various science courses, sending personal emails to students, sending individual emails to parents), and continuing to negotiate STEM club expectations and operations per student needs and school site. Our school partners also discussed concerns related to recruitment and retention strategies. Despite all of the many efforts that the school educators implemented, their virtual STEM club site competes with other extracurricular activities and students' availability. Additionally, school educators discussed issues with delivering STEM content kits because of fears that students and their families may contract the COVID-19 virus.

Ultimately, both the CISTEME365 leadership and school educators identify the pertinence of online accessibility, especially as the COVID-19 global pandemic continues to disrupt in-person activities.

Grace and empathy

CISTEME365 leadership team discussed the value and importance of monitoring and supporting individual and group needs as well as offering grace and empathy as needed. A member of our leadership team shared:

Our instructor team was agile in adapting our delivery style to meet the needs of the participants. - 4th Author

Though going virtual was difficult at first, Author 4 acknowledges the importance of adjusting content delivery to "meet the needs of participants." When school educators discussed challenges related to navigating issues of being double-booked, finding substitute teacher availability, or other challenges during full- professional development days, CISTEME365 leaders convened to offer grace and make-up work as needed. Thus, this practice gave room for participants to interact with the professional development curriculum and materials per their availability and schedule allotment. Author 4 also discussed:

Because the professional learning days were spread out, rather than all at once, we were able to incorporate feedback from participants and flexibly shift gears as needed. This included providing more time for teams to report out, reflect, and collaborate. - 4th Author

By constantly monitoring and requesting feedback, CISTEME365 leaders better learned about and empathized with the unique conditions school educators faced. Through monitoring verbal discussions during Institute sessions, morning and afternoon check-ins during Institute, optional anonymous feedback via Google forms, discussion board forums via LMS platform, one-on-one AREP coaching session, and emailing, feedback for the CISTEME365 leadership team was

crucial to develop and improve the virtual professional development delivery to meet the group and individual needs of school participants.

Lastly, school educators reflected on satisfying the student's learning interests and needs. School educators discussed the problems of supporting students' level of engagement during this time as well as the issue of delivering individual student STEM kits across the city. Knowing the challenges that COVID-19 pandemic poses on students and their families, our school partners reflected leading this work. Author 5 noted:

I think having this STEM club just allowed me to grow in empathy towards not just my students but myself. - 5th Author

Attempting to create and lead virtual STEM learning opportunities could be both frustrating and especially difficult. Nevertheless, Author 5 touches on how this work furthered capacity for and offering empathy toward themselves and their students.

Despite the COVID-19 global pandemic, both CISTEME365 leaders and school educators developed more capacity to give grace and empathy illustrated in their adjusted expectations and strategies based on feedback and observations.

Conclusion

Despite the COVID-19 global pandemic's significant changes to everyday life, our CISTEME365 professional development remained flexible and accessible to school educators. Though the CISTEME365 leadership team reports challenges related to virtual content delivery and measuring participant learning, we remain interested in examining how virtual professional development learning compares to in-person professional development learning. Though our school educators share recruitment and retention concerns with offering virtual STEM-enrichment experiences, school educators have learned much about empathizing with students (and their families) and supporting STEM interest through a virtual STEM-enrichment opportunity. By negotiating online expectations through being intentional, developing curricular materials for online accessibility, and meeting challenges with grace and empathy, we, as a CISTEME365 leadership team and school educators, will continue with our virtual plans and adjust accordingly to our constituents' diverse, ongoing, and real-time needs. We continue to serve and meet our participants' diverse needs by listening and responding to our constituents' real-time needs across the state of Illinois. Moving forward, we are interested in documenting any additional changes that we make as we finish our second year of programming.

References

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Appendix A

Figure 1.
The targeted programming features of CISTEME365

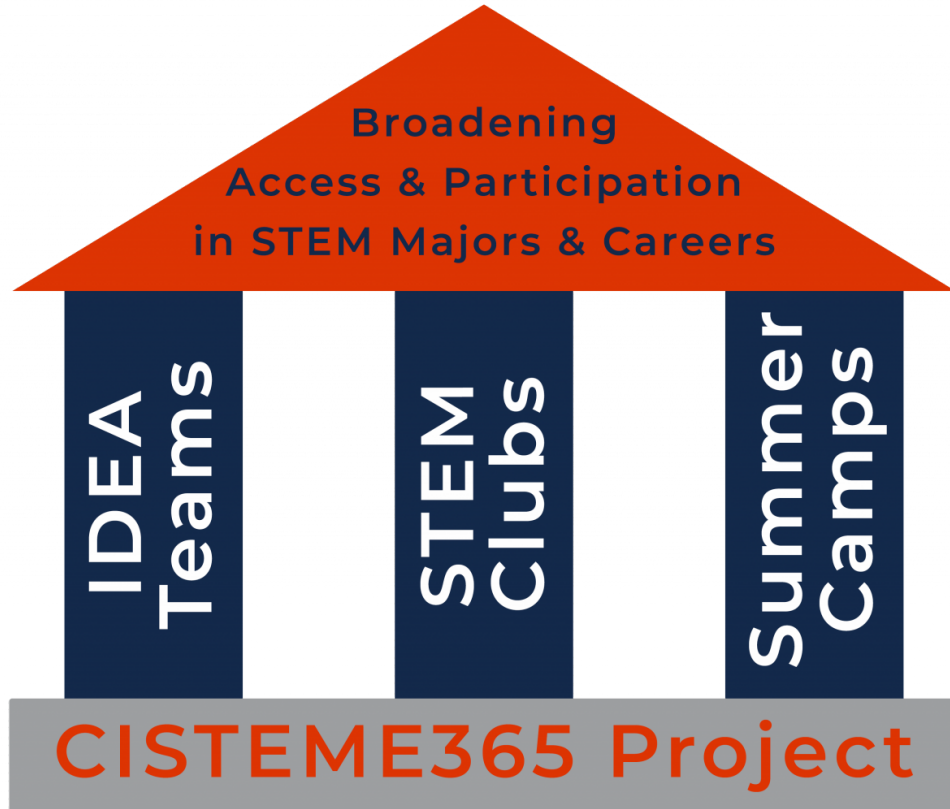


Table A. Detailing the differences in CISTEME365 programming from Year 1 (2019 - 2020) and Year 2 (2020 - 2021).

	Year 1	Year 2
IDEA Team Meetings (e.g., Institute, NIC, and AREP)	<p>Institute: 10-day, in-person during summer (5 days focused on STEM equity and the remaining 5 days focused on various STEM technical activities)</p> <p>NIC: 1 hour after school day, once per month</p>	<p>Institute: 5-day, virtual synchronous over two weeks in summer, followed by full-day, once per month until March 2021. Each with half-day STEM equity and half-day STEM technical activities)</p> <p>NIC: 1 hour embedded in full-day Institute sessions</p>

	AREP: Introduced at end of Institute	AREP: Introduced after STEM Clubs implemented in Fall 2020
STEM Clubs	In-person, meeting frequency varied per school site; clubs discontinued March 2020	Virtual, meeting frequency varied per school site
Summer Camps	Virtual	Virtual